



Forest
Service

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Subject: Insects and Pathogens in Silviculture Certification Stand

To: Jim Pitts, Zone Presale Forester

I recently met with you to observe your CEEMS certification stand for insects and disease causing pathogens. This letter describes our observations and provides technical information on the life history and management of any insects and pathogens of concern and includes recommendations for your particular site.

The 55 acre mixed conifer stand is located at about 9200 feet elevation at the base of Greens Peak. The overstory vegetation is dominated by Douglas fir with a substantial component of aspen and Engelmann spruce, and small amount of subalpine fir, white pine, and ponderosa pine. The understory is stocked with Douglas fir, subalpine fir, and aspen, the latter being heavily browsed. Total stocking is about 239 square feet of basal area per acre, averaging 568 trees per acre >1" dbh.

Pathogen and Insects

At least one insect or disease was observed affecting each tree species. Douglas fir bark beetle activity was not observed in this stand but there are two noticeable diseases, Douglas fir dwarf mistletoe and a bacterial gall. Dwarf mistletoe infection was light and fairly localized, which was supported by your survey data which showed only one of your eight points had an infected tree. Inventory trees are assigned dwarf mistletoe ratings (DMR) using Hawksworth'sⁱ 6-class system. This rating system divides the live crown of trees into thirds, and each third is rated separately as: 0, no mistletoe infection; 1, less than 50% of live branches infected; 2, more than 50% of live branches infected. The ratings for each third are totaled to obtain a DMR for a tree and a mean DMR for a site (stand) is calculated by adding the DMRs for all live trees, infected and uninfected, greater than 1 inch diameter at breast height (DBH) in the stand and dividing by the total number of trees. We did observe several severely infected understory trees within the small infection center.

Douglas-fir bacterial gall is common on moist Douglas fir sites across Arizona. The bacterium (*Erwinia* spp.) takes up residence on living limbs and causes a proliferation of host tissue. The bacterium does not kill host tissue, but galls are more noticeable on dead limbs.

Tomentosus root disease was observed in many recently downed spruce trees. Although most had snapped and failed above the root crown a few had blown over at the roots. Affected trees had advanced decay that often left only a cylinder of an inch or two thickness of solid wood remaining before the tree failed.

Small groups of 8"-to-12" dbh subalpine fir were killed by western balsam bark beetle. Mycelial



fans of armillaria root disease were observed on some of these beetle-killed trees. Several subalpine fir were damaged by black bear, which peel the bark off the base of trees in strips in order to scrape and feed on the vascular tissue with their incisors. Phellinus pini stem decay was observed in a couple of large living subalpine fir trees.

Although most groups of mature aspen trees looked healthy, there was some dieback and mortality observed that looked similar to symptoms seen throughout Arizona over the past 7 years, related to the recent drought. Aspen sprouts are heavily browsed throughout the stand and are not able to grow more than a foot in height.

Life History of Select Insects and Disease and Treatment Options to Reduce Their Impacts

Dwarf Mistletoe

The focus of managing mistletoe is frequently to reduce the impacts of mistletoe infection on forested sites. Mistletoe management is a continuous process. New dwarf mistletoe infections take 3- to 5-years (latent period) before producing aerial shoots, so not all infection can be detected and removed during one treatment. At least one treatment will be needed 5 to 10 years after an initial treatment and can be accomplished during regularly scheduled silvicultural or prescribed fire treatments.

Several features of dwarf mistletoes make them ideal candidates for cultural managementⁱⁱ:

- Dwarf mistletoes require a living host to survive. Mistletoe dies when an infected tree or branch is cut.
- Dwarf mistletoes are commonly restricted to a single host species or a group of closely related species. Non-host species can be favored during stand treatments.
- Dwarf mistletoes have fairly long life cycles and slow spread rates.
- Spread rates average only 1 foot per year. Although birds contribute to long-distance dispersal of seeds, this is rare and of little practical significance from a control perspective.
- Southwestern dwarf mistletoe-infected ponderosa pine trees are generally easy to detect due to the presence of yellow-orange shoots and witches' brooms. Trees in heavily infested stands show signs of short stature, decline, and mortality.

Managing dwarf mistletoe is difficult in stands under uneven-age management because younger trees become heavily diseased from seeds showering down from infected overstory trees. Spread from overstory to understory is rapid. Initially, all infections in the young stand develop directly from seeds produced from overstory trees. Then there is a transition period when infections in the young stand begin to produce seeds that further infect the stand. Subsequently, infection in the young stand progresses outward beyond the range of the seeds produced in the overstory stand. Researchers^{iii iv} measured the distance of infected seedlings from the source of overstory trees at different time intervals. In 20-year-old trees, nearly all infection was found to be attributable to seed produced in the overstory with 80 percent of infected seedlings within 35 feet of the infected overstory trees. In 50-year-old trees, lateral spread accounted for about one-half

of the spread in open stands and one-third of the total in dense stands, with distances from the original overstory seed source reaching nearly 80 feet and 65 feet, respectively.

If uneven-aged treatments are to be applied in dwarf mistletoe infected stands, the sites should have very low levels of mistletoe and the mistletoe dispersed in defined patches. Group selection could be used to effectively remove infected trees and limit spread.

Prescribed burns can also be used to reduce dwarf mistletoe infection levels. Heavily infected trees have been shown to have reduced post-burn survival rates compared to lightly infected or non-infected trees^v^{vi}. Limbs located in the lower crowns of trees are killed during fire. Since dwarf mistletoe infections are generally more abundant in the lower crowns of infected trees, infection levels are decreased by the death of lower limbs.

Tomentosus Root Disease

Inonotus tomentosus is primarily a pathogen of spruce where it is often called “stand opening disease” due to premature windfall and mortality. Although it infects Douglas-fir and other conifers in Arizona, it has not been shown to cause blowdown in these species. *Tomentosus* root disease spreads primarily by root-to-root contact, although infection by spores can occur through deep wounds in roots. The fungus spreads both outward in roots and a few meters up into the butt of an infected tree. Decay from *tomentosus* is more advanced in larger and older trees, due to longer exposure and larger root systems^{vii}. Blowdown of living trees due to *tomentosus* root disease contributes to spruce beetle activity, although less so after an outbreak has begun^{viii}.

Like other root diseases, *tomentosus* root disease is often called a “disease of the site” because the fungus survives for decades in roots of living and dead trees and is able infect susceptible regeneration as it develops. The most effective management tool is to favor resistant tree species. Although promoting less susceptible conifers is helpful, regenerating with hardwoods like aspen deprives the fungus of suitable host material as the spruce root supply is eventually depleted.

Western Balsam Bark Beetle

Endemic populations of western balsam bark beetle are found in trees that are overmature, infected with root disease, or storm-damaged. Populations can start to build during periods of drought or environmental stress. During outbreaks larger diameter trees are more susceptible and tree mortality tends to be grouped. In some areas, chronic infestations develop killing small groups of trees each year. Pitch tubes do not usually form on infested trees. Often entrance holes and boring dust are visible and sometimes long narrow flows can be seen coming flowing down the tree from the site of entry. Trees generally fade to yellowish-green within a year of attack. The most effective management tool is to favor resistant tree species.

Recommendations

Treatments to mitigate mistletoe impacts should be integrated with other treatment activities such as reducing stand susceptibility to fire or insect outbreaks. Uneven-aged treatments can be considered in this lightly infested mixed species stand where group selection can be used to target the removal of infected trees. Increasing space between trees helps limit spread because seeds of dwarf mistletoe are explosively released and typically travel 10 to 40 feet from a fruit bearing plant. This reduces infection levels while still allowing trees to grow to maturity. Regardless of the emphasis on even-aged or uneven-aged stands, monitoring for follow-up

treatments in 5 to 10 years is recommended.

Favoring Douglas fir and aspen during thinning treatments will reduce the impact of western balsam bark beetle on subalpine fir and tomentosus root disease on spruce. Fencing needs to be considered in order to protect aspen regeneration from browsing by wild and domestic ungulates.

There is a potential for Douglas-fir beetle caused mortality. Based on studies in the Rocky Mountains, Douglas-fir beetles preferentially attack large, old trees in dense stands with a high Douglas-fir component^{ix}. Active stand management (thinning) provides the best long term prevention or minimizing damage by Douglas-fir beetle^x, and a fuels reduction project should help to lower stand risk. However, log decks, thinning slash, and subsequent burning may pose a short-term risk to residual trees in the thinning unit or surrounding areas. Timing of thinning treatments, chipping, and placement of potential brood material in open areas should help to minimize potential impacts.

If you have any questions, please contact me at (928) 556-2075.

/s/ Mary Lou Fairweather

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cc: John Anhold

ⁱ Hawksworth, F.G. 1977. The 6-class dwarf mistletoe rating system. USDA Forest Service, General Technical Report RM-48. 7pp.

ⁱⁱ Johnson, David W.; Hawksworth, Frank G. 1985. Candidates for control through cultural management. In: Loomis, Robert C; Tucker, Susan; Hofacker, Thomas H. Insect and disease conditions in the United States, 1979-83: What else is growing in our forests? Gen. Tech. Rep. WO-46. Washington, DC: U.S. Department of Agriculture, Forest Service, State and Private Forestry, Forest Pest Management: 48-55.

ⁱⁱⁱ Gill, L.S. and F.G. Hawksworth. 1954. Dwarf mistletoe control in southwestern ponderosa pine forests under management. Jour. Forestry 52: 347-353.

^{iv} Hawksworth, F.G. 1961. Dwarf mistletoe of ponderosa pine in the Southwest. Tech. Bull. 1246. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station. 13p.

^v Alexander, M.E. and F.G. Hawksworth. 1976. Fire and dwarf mistletoes in North American coniferous forests. Jour. Forestry. 74 (7): 446-449.

^{vi} Conklin, D.A. and W.A. Armstrong. 2001. Effects of three prescribed fires on dwarf mistletoe infection in southwestern ponderosa pine. USDA Forest Service, Southwestern Region, Forestry and Forest Health. R3-01-02. 17 p.

^{vii} Lewis, K.J., 1997. Growth reduction in spruce infected by Inonotus tomentosus in central British Columbia. Can. J. For. Res. 27, 1669-1674.

^{viii} Lewis, K.J. and B.S. Lindgren. 2002. Relationship between spruce beetle and tomentosus root disease: two natural disturbance agents of spruce. Can. J. For. Res. 32, 31-37.

^{ix} McMillin, J.D. and K.K. Allen, 2003. Effects of Douglas-fir beetle (Coleoptera: Scolytidae) infestations on forest overstory and understory conditions in western Wyoming. West. N. Amer. Natur., 63: 498-506.

^x Schmitz, R.F. and Gibson, K.E. 1996. Douglas-fir beetle. USDA For. Serv. Forest Insect and Disease Leaflet 5. 8 p.